

Kinetics of H₂O(010) - O₂(v=1) Vibrational Energy Transfer at Low Temperatures.

Completed Technology Project (2018 - 2021)



Project Introduction

SRI International proposes a laboratory study aimed at improving the reliability of non-local thermodynamic equilibrium (non-LTE) models for retrieval of water vapor number density profiles in the Earth's mesosphere and lower thermosphere (MLT) regions. In the current non-LTE models, the collisional process that presents the largest source of uncertainty is the vibration-to-vibration (V-V) energy exchange between H₂O(010) and O₂(1). In the proposed project, the rate coefficient for this process will be determined as a function of temperature, including low temperatures relevant to the MLT region. The published estimates of this rate coefficient span almost an order of magnitude, and the experiments at and above room temperature yielded a value 2-3 times lower than the values typically derived by modeling the infrared emissions from H₂O(010). Low-temperature laboratory measurements are essential to constrain the models and enable reliable water density retrieval from measured infrared emissions. The proposed experiments will employ a state-selective two-laser approach. Vibrationally excited populations of the two species will be produced using stimulated Raman scattering (SRS) or ozone photolysis. The kinetics of the V-V transfer will be investigated via resonance-enhanced multiphoton ionization (REMPI) detection of H₂O(010) and O₂(1), infrared absorption, or emission. The rate coefficient will be measured in the 220-300 K temperature range, providing data that will enable a reliable extrapolation to even lower temperatures. The results of this investigation will have a crucial positive impact on the quantitative extraction of the water vapor altitude profiles from the 6.3 micrometer emission channel of the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) instrument aboard the Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics (TIMED) satellite.



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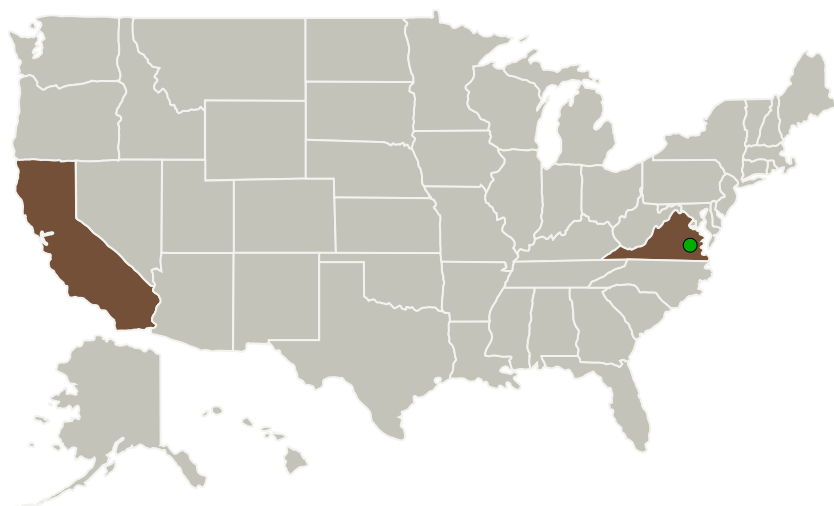
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
SRI International	Lead Organization	Industry	Menlo Park, California
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations

California	Virginia
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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Organization:

SRI International

Responsible Program:

Heliophysics Technology and Instrument Development for Science

Project Management

Program Director:

Roshanak Hakimzadeh

Program Manager:

Roshanak Hakimzadeh

Principal Investigator:

Daniel Matsiev

Co-Investigators:

Kevin C Morrissey
Martin G Mlynczak
Konstantinos Kalogerakis

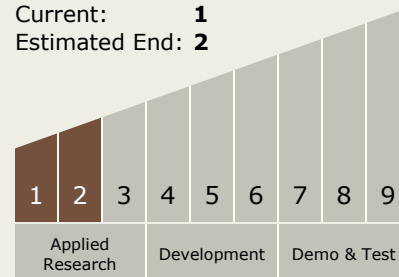
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Technology Maturity (TRL)

Start: **1**
Current: **1**
Estimated End: **2**



Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.1 Remote Sensing Instruments/Sensors
 - └ TX08.1.1 Detectors and Focal Planes

Target Destination

The Sun